Geodetic constraints on mantle anelasticity

John Wahr, Department of Physics, University of Colorado, Boulder, Colorado 80309-0390

Among Tony Dahlen's many significant contributions were a number of exquisite studies of the Earth's variable rotation.
In one of these studies, published in 1981, Martin Smith and Tony looked at the effects of mantle anelasticity on the period and damping of the Earth's 14-month Chandler Wobble (CW). The physical processes responsible for anelasticity are not well understood, even today. The dissipation of seismic energy seems to be caused by different mechanisms than those controlling viscous mantle flow. But the details of those mechanisms and their relative importance at intermediate periods and stress levels, is unclear. Smith and Dahlen were able to use CW observations to place constraints on the difference in the strength of anelasticity between seismic periods and 14-months.

In this talk I will describe an extension of Smith and Dahlen's general formalism to include other types of geodetic observations as well. Geodetic observations offer perhaps the only means of probing mantle anelasticity at periods between one hour (the longest seismic period) and thousands of years (the time scale of post glacial rebound). We find we are able to explain a number of these observations (the fortnightly and monthly tidal variations in the length-of-day, and the M2 and 18.6-year gravity tides, in addition to the CW period and damping) with a single frequency-dependent mantle Q model. We find the observations are consistent with a single absorption band stretching from seismic frequencies out to periods of at least 18.6 years. The frequency-dependence of Q within that band is consistent with a power law with an exponent of between 0.2 and 0.3.